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GOULD DEMODULATOR AMPLIFIER
MODEL 13-4616-00

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MANUAL PART NO.
13-804616-00

GOULD DEMODULATOR AMPLIFIER
MODEL 13-4616-00

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SECTION I

GENERAL INFORMATION

1.1 SCOPE

This manual contains specifications, installation instructions and operating and maintenance instructions for the Gould Demodulator Amplifier, Model 13-4616-00. In addition, a theory of operation, calibration procedures and parts breakdown are included.

1.2 DESCRIPTION

The Gould Demodulator Amplifier, Model 13-4616-00 is a plug-in amplifier compatible with Gould 1704 or 2000 Series Recording Systems or in a portable case for use with other type readout instruments. This unit provides phase sensitive demodulation of amplitude modulated low level carrier type signals. The unit has separate independent circuitry for error and reference signals, each isolated from its respective source. Internal controls have been provided for reversing the polarity of the input signal as well as the calibration signal, and also for selecting carrier band filter cutoffs. The preamplifier also features a switch selectable DC preamplifier with a response from DC to 200Hz.

FIGURE 1-1 GOULD DEMODULATOR AMPLIFIER MODEL 13-4616-00

Internal Calibration	0 and 100% on 5V attenuator setting.
Voltage	5 volt peak ±1% at carrier frequency.
Instability	Referred to input, 15 minute warm-up.
With Time	±0.1%/24 hours.
With Temperature	±0.1%/°C.
With Reference Input	±0.1% from 10 to 120Vrms.
Common Mode	1K unbalance (either input to chassis).
DC Rejection	Greater than 140dB.
50 or 60Hz Rejection	Greater than 90dB.
Quadrature	Phase control adjusted for maximum output.
Rejection	Greater than 40dB.
Signal Channel - DC	
Circuit	Differential, balanced to common.
Impedance	2 megohm differential, 1 megohm each input to common.
Voltage Range	.025 to 500 volts peak for full scale output.
Attenuator	8 steps, .025, .050, .100, .250, .500, 1.0, 2.5, 5 volts full scale.
Inaccuracy	±.5%.
Maximum Voltage	500 volts peak AC or DC.
Attenuator Multiplier	X1/X100.
Inaccuracy	±.5%.
Maximum Voltage	500 volts peak AC or DC.
Variable Sensitivity	Greater than 2.5:1 multiplier.
Frequency Response	In conjunction with output amplifier.
No Output Filters	Down less than 1% @ 100Hz.
6, 40, 120Hz Internal Output Filters	Down less than 1dB, at selected settings, filter rolloff 18dB/octave.
Common Mode	1K unbalance (either input to chassis).

DC Rejection	Greater than 90dB.
50 or 60Hz Rejection	Greater than 70dB.

AMPLIFIER OUTPUT

Circuit	Single ended to common.
Voltage	0 to ±5.0V into 2Kohms or greater.
Impedance	Less than 1ohm.
Non-Linearity	±0.5% full scale.
Frequency Response	3 filter networks + direct.
Internal Filter Settings	6, 40 and 120Hz (10% of carriers).
Response	Down less than 1dB at corner, 18dB/octave rolloff.

Combined Instability %F.S.

	Zero	Gain
With Time	±0.1%/24 hours	±0.02%/24 hours
With Temperature	±0.08%/°C	±0.05%/°C
With 10% Line Change	±0.2%	±0.02%

Noise

Demod Mode	Less than 0.4% peak-peak random of full scale setting + 1% of 2X carrier frequency.
DC Amp Mode	Less than 1.0% peak-peak of full scale from DC to 100Hz with demodulator input shorted.

ENVIRONMENT

Temperature

Storage	-40°C to +70°C.
Operating	0 to 50°C.
Relative Humidity	Non-condensing.
0 to 35°C	90%.
35 to 50°C	70%.
Accessories Supplied	One input mating connector (P-101) Gould Part No. 11-5407-10.

Optional Case Assembly (X designates number of channels)

Portable.	11-41X3-01.
Rack Mount	11-45X8-15.

SECTION II

INSTALLATION

2.1 GENERAL

This section describes the checks and inspections that should be made upon receiving the Gould Demodulator Amplifier, Model 13-4616-00 with a 2000 series unit. It covers installation procedures, signal input connections, and outline dimensions.

2.2 INITIAL INSPECTION

Prior to attempting any electrical connections or operation, visually examine the unit for broken or loose knobs, dented or nicked panels and broken or chipped rear connectors.

2.3 INSTALLATION

Preamplifier Model 13-4616-00 may be mounted in Gould 2000 Recorder frames, rack mounted separately in a Gould rack adapter kit, or installed in a Gould portable carrying case.

a. Insertion

To install the preamplifier into its appropriate slot:

1. Slide the preamplifier into the enclosure until the rear output card edge connector is engaged.
2. Tighten the rear retaining screw. This locks the preamplifier into the enclosure.
3. Connect the 14-pin plastic input signal connector and secure it by turning clockwise the threaded plastic locking ring.

b. Removal

1. Disconnect the input connections with a counterclockwise turn and pull.
2. Loosen the rear retaining screw. The preamplifier will move forward about 1/8 of an inch.
3. Carefully slide the entire preamplifier out of the Gould 2000 enclosure.

2.4 SIGNAL CONNECTIONS

a. Input Connection Hardware

NOTE: For signal input connections, use the special connector provided with the preamp (Gould Model Number 11-5407-10).

Connections to the preamplifier are made at the rear. (Figure 2-1). See Figure 2-2 for pin connections.

c. Output and Power

The amplifier is designed to operate on + and -15 volt, 100 ma regulated supplies. Output and power connections are provided through an 8-pin card edge on the rear of the preamplifier (Figure 2-3). The mating connector is located in the recorder chassis.

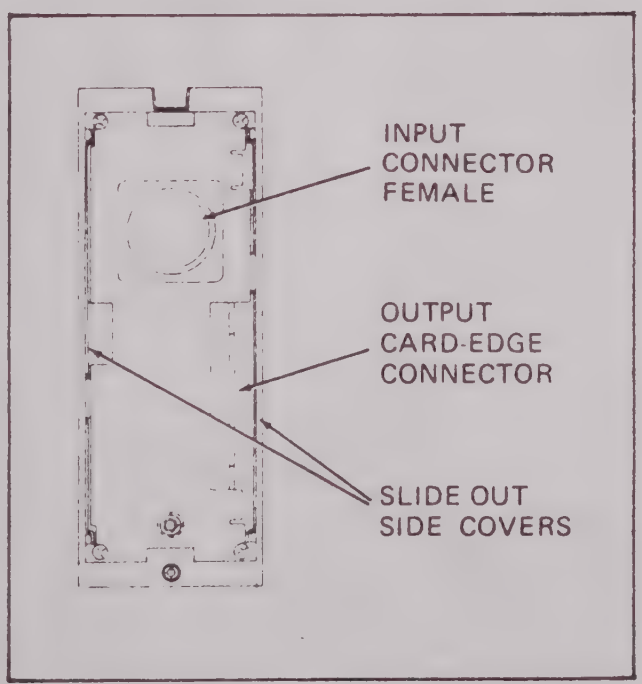
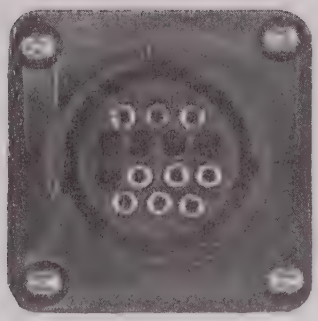
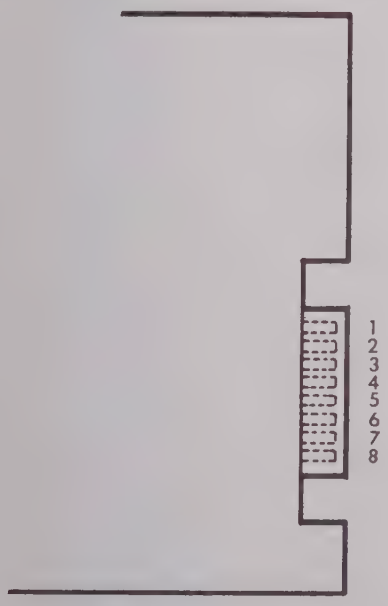


FIGURE 2-1 REAR VIEW



PIN 1. . . . . .+ DC INPUT
PIN 2. . . . . - DC INPUT
PIN 3. . . . . GUARD
PIN 8. . . . . + CARRIER SIGNAL
PIN 9. . . . . - CARRIER SIGNAL
PIN 10. . . . . GUARD
PIN 12. . . . . + CARRIER REFERENCE
PIN 13. . . . . - CARRIER REFERENCE
PIN 14. . . . . GUARD

FIGURE 2-2 INPUT CONNECTOR



PIN 1. . . . . .POWER COMMON
PIN 2. . . . . .SIGNAL OUTPUT
PIN 3. . . . . -15V DC SUPPLY
PIN 4. . . . . .+15V DC SUPPLY
PIN 5. . . . . SIGNAL COMMON
PIN 6. . . . . (NOT USED)
PIN 7. . . . . (NOT USED)
PIN 8. . . . . (NOT USED)

FIGURE 2-3 OUTPUT CONNECTIONS

2.5 OUTLINE DIMENSIONS

Refer to Figure 2-4 for outline dimensions.

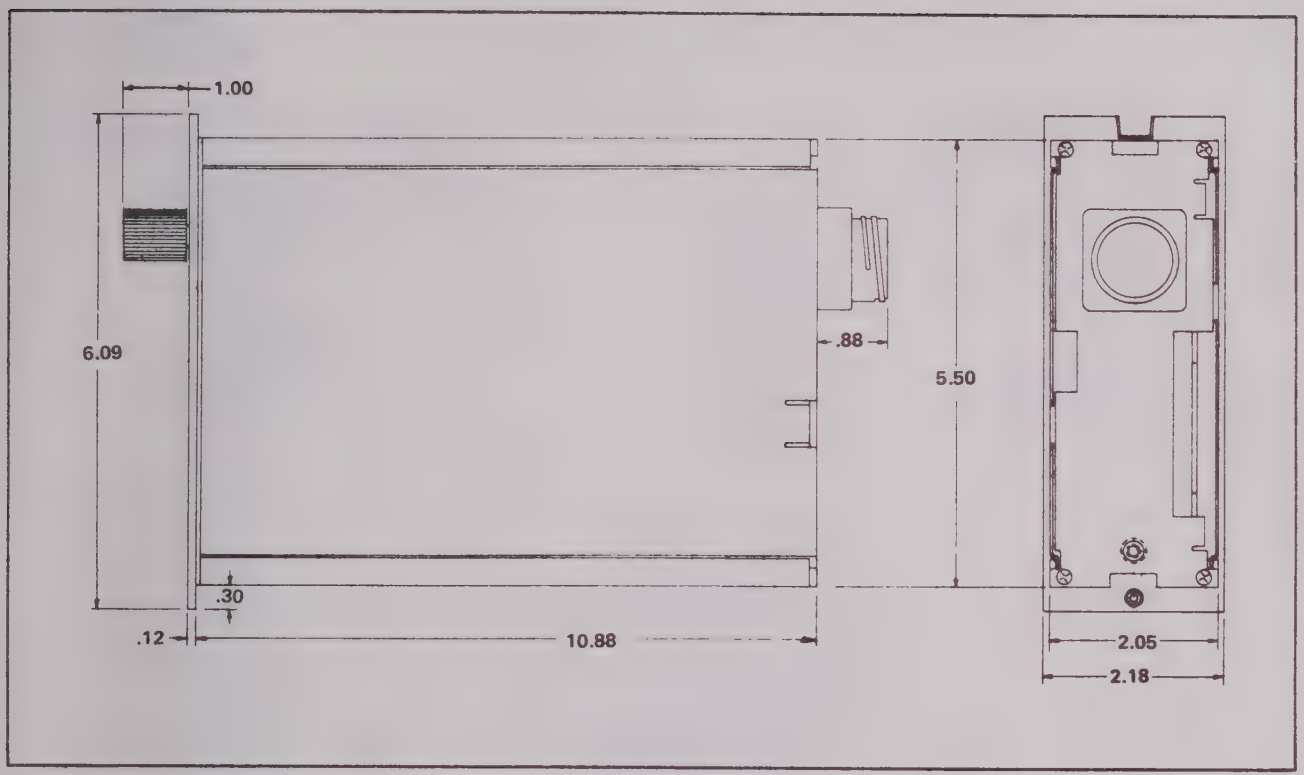


FIGURE 2-4 OUTLINE DIMENSIONS

SECTION III

OPERATION

3.1 GENERAL

This section describes and illustrates the controls of the Demodulator Amplifier, Model 13-4616-00, and provides complete operating instructions.

3.2 FRONT PANEL CONTROLS

Item numbers below refer to circled numbers in Figure 3-1.

ITEM	CONTROL	DESCRIPTION
1	DEMODULATOR - VOLTS FULL SCALE ATTENUATOR	Eight position VOLTS FULL SCALE attenuator switch, which selects full scale values of .025, .05, .1, .25, .5, 1, 2.5 and 5 volts when the VARIABLE SENSITIVITY (item 2) and the ATTENUATOR MULTIPLIER (item 11) are in the X1 mode.
2	X1 SENSITIVITY	Vernier SENSITIVITY control provides for overlapping ranges with stepless adjustment between 1 and 2.5 times FULL SCALE STEP SENSITIVITY selection.

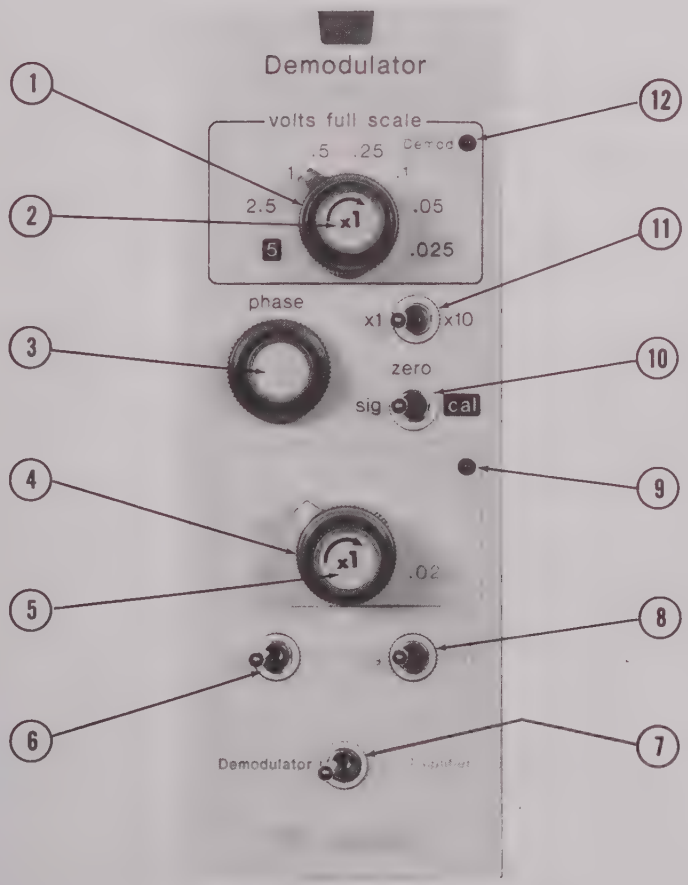


FIGURE 3-1 FRONT PANEL CONTROLS

ITEM	CONTROL	DESCRIPTION
3	PHASE	Provides adjustment of the phase relationship between input signal and reference over a range from 0° to -165°. A locking knob has been provided to prevent inadvertent turning.
4	DC AMPLIFIER - VOLTS FULL SCALE ATTENUATOR	Eight position VOLTS FULL SCALE ATTENUATOR switch, which selects full scale values of .025, .05, .1, .25, .5, 1, 2.5 and 5 volts when the VARIABLE SENSITIVITY (item 5) and the ATTENUATOR MULTIPLIER (item 6) are in the X1 mode.
5	X1 SENSITIVITY.....	Vernier SENSITIVITY control provides for overlapping ranges with stepless adjustment between 1 and 2.5 times FULL SCALE STEP SENSITIVITY selection.
6	X1-X100 ATTENUATOR.....	Provides attenuation of 100:1 of DC amp input signal, allowing a maximum of 500 volts peak AC or DC while in the 5 volt full scale range.
7	MODE SELECT	Switches the module output between the Demodulator section and the DC amplifier section.
8	SIG-ZERO.....	Allows for a ZERO reference input to the DC amplifier.
9	INDICATOR.....	Illuminates when the DC amplifier section has been selected (item 7).
10	SIG-ZERO-CAL	Three position function switch which selects a full scale calibration signal when in the CAL position, (and the DEMODULATOR VOLTS FULL SCALE is in the 5 volt position). A zero reference when in the zero position, and passes the input signal when in the SIG position.
11	X1-X10.....	Provides attenuation of 10:1 of Demod input signals allowing a maximum of 125 volts peak while in the 5 volt attenuator range and the VERNIER SENSITIVITY (item 2) is full counterclockwise.
12	INDICATOR.....	Illuminates when the DEMODULATOR section has been selected (item 7).

3.3 INTERNAL CONTROLS

Refer to Figure 3-2 for internal control locations.

SIGNAL NORMAL/REVERSE. . . . . SWITCH (S2)	Reverses polarity of output signal to recorder.
CALIBRATION SIGNAL . . . . . NORMAL/REVERSE SWITCH (S1)	Reverses deflection of the pen when calibration signal is applied. (Note: Reference signal input must be applied to receive calibration signal.)
CARRIER FREQUENCY . . . . . SELECT SWITCH (S8)*	Selects the capacitor for 60, 400 or 1200Hz carrier frequency operation.
OUTPUT FILTER SWITCHES . . . . . (S5, S6 and S7)*	Selects capacitor for 6, 40, or 120Hz filtering.

*Select by CLOSING desired switch and setting other two OPEN.

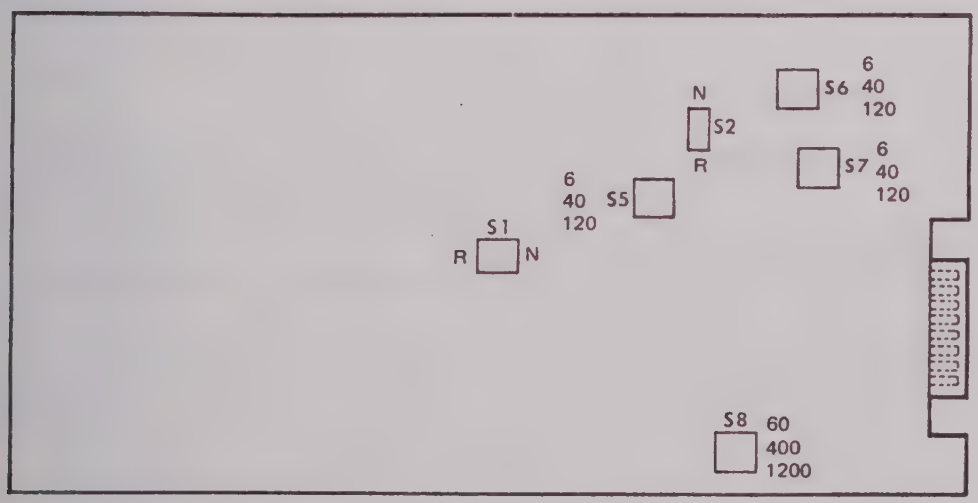


FIGURE 3-2 INTERNAL CONTROLS

3.4 OPERATION - DEMODULATOR

1. Remove side cover and check that internal controls are in the appropriate position (para. 3.3).

2. Replace side cover and install unit into recorder.

3. Set front panel controls as follows: (See Figure 3-1).

   MODE SELECT ..... DEMODULATOR
   SIG-ZERO-CAL .....ZERO
   PHASE .... FULL COUNTER-CLOCKWISE
   VOLTS FULL SCALE .....5 VOLTS
   X1-X10..... X1
   X1 SENSITIVITY...X1-FULL CLOCKWISE (detent)

4. Connect signal and 10Vrms minimum reference input to preamplifier (para. 2.4).

5. Apply power to recorder and run at slow speed.

6. With preamplifier SIG-ZERO-CAL switch in the ZERO position, adjust the recorder pen position control to the desired zero reference.

7. Switch the SIG-ZERO-CAL switch to the SIG position.

8. Adjust the PHASE control for the maximum pen deflection.

9. Switch the VOLTS FULL SCALE control and/or the X1-X10 switch for the best reading.

10. The calibration feature may be used as follows: with a reference signal in (10Vrms minimum), setting the SIG-ZERO-CAL switch to CAL provides a 5 volt input signal. With the DEMOD VOLTS FULL SCALE set to 5 and the X1-X10 switch to X1, a full scale signal will be sent to the recorder. With the X1-X10 switch set to X10, the DEMOD VOLTS FULL SCALE and X1 sensitivity vernier may be used to set any desired signal input level to be full scale on the recorder.

3.5 OPERATION - DC AMPLIFIER

1. Remove side cover and set internal OUTPUT FILTER SWITCHES depending on signal frequency. For maximum frequency response all switches (S5, 6 and 7) should be OPEN.

2. Set the MODE SELECT switch to the DC AMPLIFIER position.

3. Apply input to the amplifier (para. 2.4).

4. Set the SIG-ZERO switch to the ZERO position.

5. Run recorder at slow speed and adjust the pen position control for zero reference.

6. Switch the SIG-ZERO switch to the SIG position and adjust ATTENUATOR control for best reading.

SECTION IV

THEORY OF OPERATION

4.1 GENERAL

The Demodulator/DC Amplifier, 13-4616-00, consists of four sections, Reference Channel, AC Signal Channel, DC Signal Channel and the Output Amplifier. Schematic 295744 shows the circuits on the printed circuit board and Drawing 295949 shows the front panel controls and connections to the p.c. board. The Reference and AC Signal channels constitute a demodulator for conditioning 60, 400, or 1200Hz carrier type signals. The DC Signal channel conditions DC to 100Hz signals. The Output Amplifier provides 6, 40, 120Hz filtering for use with the demodulator section and, with the filter switches OFF, direct amplification of the DC Channel signal which has a corner frequency of about 1.5KHz and rolls off at 6dB/ octave.

4.2 CIRCUIT DESCRIPTION

a. Reference Channel

The Reference Channel consists of transformer T2, Integrated Circuits U2, U4 and U7 with their associated components. T2 is a 16:1 step down transformer and presents over a 1 megohm input impedance to the reference signal. U4A, B and C and U7 constitute an automatic gain control which maintains a constant amplitude of 5 volts peak at TP1 over a 10 to 125Vrms reference signal input range independent of frequency. This signal is used as the calibration signal in the AC signal channel and to obtain the 0 to -165° phase shift reference for the demodulator. U4D inverts the signal present at TP1 and connects it to one end of either capacitor C5, C6 or C7, selected to be compatible with the frequency. The front panel phase control, R102, connects between TP1 and the other side of the capacitor. As the phase pot is varied from 0 to 150Kohm the phase of the signal at the output of U2A shifts with respect to the TP1 signal from 0 to -165°. This signal to the zero crossover detector U2B, drives the inverting comparator U2C. Depending on the position of the signal polarity switch (S2), the transistor Q-1 is turned on or off in phase with the signal at the output of U2A. U2D, its associated components, and Q-1 constitute the demodulator. When the transistor Q-1 is off, the gain of U2D is -1 and when the transistor is on, the gain is +1.

b. AC Signal Channel

The AC Signal Channel consists of transformer T1, the attenuator S101, Integrated circuits U7 and U8, and their associated components. T1 is a 16:1 step down transformer and presents over a 1 megohm input impedance to the signal selected by the SIG/ ZERO/CAL switch, S103, on the front panel. The attenuator sets the peak full scale voltage range from .025 to 5V with the front panel X1/X10 switch, S102, in the X1 position or .25 to 50 volts in the X10 position. U1 amplifies the signal from the attenuator by about 80. The DC gain of this stage is 1, due to C-28 which eliminates excessive amplifier drift. The output of U1 connects to the X2.5 to X1 sensitivity control. In the X2.5 position the input attenuator settings are multiplied by 2.5. U8 is a gain of 4 or 40 amplifier, depending on the X1/X10 switch (S102). The output of U8 is converted to DC by the phase sensitive demodulator U2D. When the frequency of the signal and the reference inputs are the same, a peak DC output can be obtained by adjusting the phase control R102 on the front panel. Under these conditions the output of U2D is a full wave rectified sine wave, the polarity of which is a function of whether the signal is in phase or 180° out of phase with the demodulator reference. This polarity can be changed by using signal polarity switch S2 on the P.C. board.

c. DC Signal Channel

The DC Signal Channel consists of the input attenuator S104, Integrated circuits U5, U6 and their associated components. With the X1/X100 switch (S105) in the X1 position, the attenuator is a 2 megohm differential input impedance to the signal on J101-1 and 2. With the X1/X100 switch in the 100 position the input impedance is still 2 megohm differential but the signal is attenuated by 100. When in the X1 position the attenuator full scale range is .025 to 5V peak AC or DC. In the X100 position the range is 2.5 to 500V. The 2.5:1 sensitivity control, R103, further multiplies the ranges by a factor of 1 to 2.5. U5A, B and U6A constitute an instrumentation type amplifier with a gain of about 130.

d. Output Amplifier

The Output Amplifier consists of U3A and B and their associated components. With the Demod/DC amp switch S107 in the Demod position, the Demod indicator light is on and the output amplifier connects to the demodulator output U2D-1. In the DC amp position, it connects to the DC amplifier output U6B-7. The output amplifier has a gain of 1.5 and allows the operator to choose either 6, 40 or 120Hz filters by changing the switches to appropriate capacitors. The filters are designed to be down less than 1dB at 10% of the demodulator reference frequency, with an 18dB/octave roll off. In the DC amplifier mode the capacitors may be disconnected and the frequency response will be controlled by the time constant in U6B feedback network. This time constant is designed to roll off the frequency at 6dB/octave and to be down less than 1% at 100Hz. A full scale input to either the demodulator or DC amplifier section will have an output of ±5Vdc depending on the phase or polarity of the input signal.

SECTION V

CALIBRATION

5.1 GENERAL

In addition to calibration procedures, this section contains paragraphs on performance checks and maintenance.

5.2 CALIBRATION

a. General

The Gould Demodulator Amplifier has been accurately calibrated before shipment from the factory, and therefore should give long, trouble-free service. Should re-calibration be required, it should be performed by qualified technical personnel only.

CAUTION: CALIBRATION SHOULD NOT BE ATTEMPTED UNLESS SUITABLE, SPECIFIED TEST EQUIPMENT IS USED.

NOTE: This procedure is broken down into sub-paragraphs by individual adjustments. Under normal conditions, complete calibration should be performed every six months. After repair of the unit or some other change in the electronics it is necessary only to re-calibrate those circuits affected by the change.

b. Equipment Required

The following is a list of test equipment necessary for calibration and performance checks:

1. Digital Multimeter - Keithley, 179 True RMS or equivalent. (2 required).
2. Function Generator - (10Vrms output required) Wavetek 142 or equivalent.
3. Phase Lock Generator - Wavetek 186 or equivalent.
4. Phase Meter - Kronhite 6200A or equivalent.
5. Isolated AC Source, 120 volt, 60Hz (Figure 5-2).
6. Variac - General Radio W5MT3AW or equivalent.
7. DC Voltage Source - 0V - 500V, Valhalla 2701A or equivalent.
8. Oscilloscope - Dual Channel and differential inputs.
9. Decade Voltage Divider - General Radio 1454 or equivalent.
10. Trimmer for Decade Divider (See Figure 5-2).
11. Gould 2000 Series Chart Recorder.
12. Extender Card and Cable Assembly, Gould Part Number 887291.

c. Initial Procedure

1. Set internal controls as follows (See Figure 5-1). S5, 6, 7 and 8: select by CLOSING desired switch.

   Filter Switches S5, S6, S7 . . . . . 40Hz
   Carrier Frequency Switch S8. . . . . 400Hz
   Calibrator Signal Polarity S1 . . . . . Normal
   Signal Polarity S2 . . . . . Normal

2. Set front panel controls as follows: (See Figure 3-1).

   Demodulator Section:

   Volts Full Scale. 5
   X1-X10 . . . . . X1
   Variable Gain . . . . . X1 (CW-Detent)
   Sig-Zero-Cal. . . . . Zero
   Phase. . . . . Full CCW

   DC Amplifier Section:

   Volts Full Scale. 1
   Variable Gain . . . . . X1 (CW-Detent)
   Sig-Zero. . . . . Zero
   X1-X100 . . . . . X1

3. Connect the amplifier to a 2000 Series Chart Recorder using the Extender Card and Cable Assembly (P/N 887291). Apply power.
4. Set the Demodulator/DC switch to Demodulator. The Demodulator LED should be lit and the DC LED should be off.
5. Apply 10Vrms ±.1Vrms 400Hz sine wave to the reference input (pin 12 high, pins 13 and 14 (tied together) low).

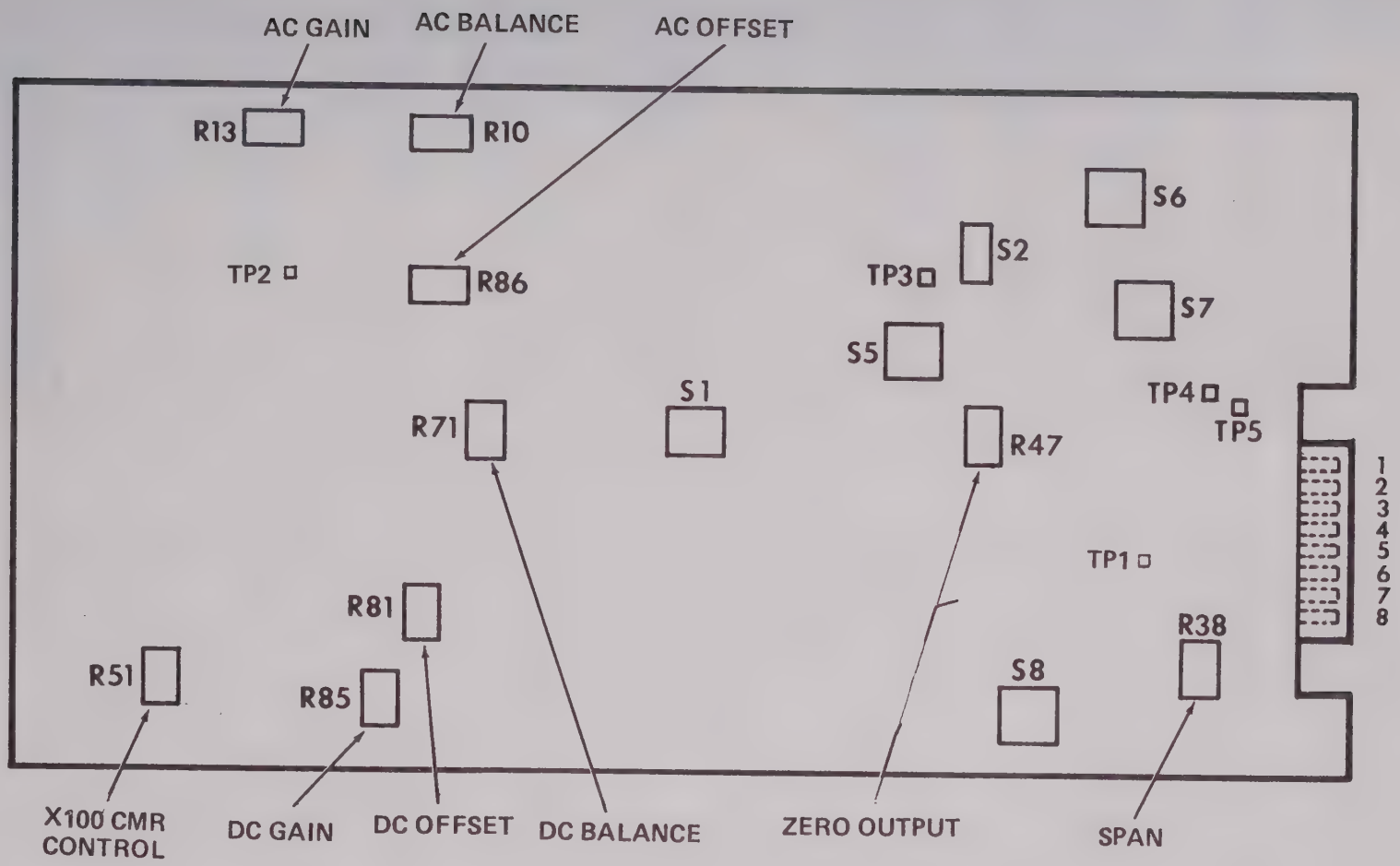


FIGURE 5-1 CALIBRATION CONTROLS

6. Allow 15 minutes warm-up.

d. Demodulator Calibration

1. Connect the DVM to TP1 (high) and TP5 (low). Adjust the Calibration Span control, R38, for 3.53Vrms within 5mVrms as read on the DVM. (See Figure 5-1).

2. Connect the DVM to TP2 (high) and TP5 (low). Adjust the AC balance, R10, for 0.0 volts DC within 1mV. Disconnect DVM.

3. Connect channel 1 of the dual channel oscilloscope to TP1 and channel 2 of the oscilloscope to TP3. Connect oscilloscope grounds to TP5.

4. Set the sweep rate to 1MS/CM. Set channel 1 gain to 5V/CM and channel 2 gain to .1V/CM. Sync the scope to channel 1.

5. Adjust AC offset, R86, for best null on the channel 2 trace.

6. Rotate the front panel Demodulator variable gain control full CCW and back to full CW. The null on channel 2 of the scope should not change by more than .1V p-p. If it does, repeat steps 2 thru 5. Disconnect scope.

7. Set the demodulator variable gain to full CW and connect the DVM to TP4 (high) and TP5 (low). Adjust the ZERO OUTPUT control, R47, for 0.0 volts DC within 5mV.

8. Set the Cal/Sig/Zero switch to CAL and rotate the front panel phase control near full CCW to obtain the maximum POSITIVE output.

9. Adjust the AC Gain control, R13, for 5.0 volts DC within 5mV as read on the DVM.

e. DC Amplifier Calibration

NOTE: DC Amplifier section not intended for operation with a reference signal input.

1. Set the Demod/DC switch to DC and note the DC LED comes on and the Demod LED goes off. Set the Sig/Zero switch to Zero. Connect the DVM to TP4 (high) and TP5 (low).

2. Alternately rotate the DC variable gain control full CW and full CCW. Adjust the DC balance control, R71, to reduce the change in the output from full CCW to full CW to less than 5mV DC.

3. Set the variable gain to full CW. Adjust the DC offset control, R81, for 0.0 volts DC within 5mV as read on the DVM.

4. Set the DC full scale switch to 1 volt and the Sig/Zero switch to Signal. Apply 1Vdc to the DC input pins 1 (high) and pins 2 and 3 (tied together), low.

5. Adjust DC Gain, R85, for 5.0 volts DC within 5mV.

6. Set the X1/X100 switch to X100, the DC full scale to .025. Connect an oscilloscope to TP4 high, and TP5, low. Set output filters for maximum bandpass (no filtering), i.e., S5, S6 and S7 all OPEN.

7. Apply 5Vrms, 60Hz sine wave to input pin 3 (high), and pins 1 and 2 (tied together), low. Adjust the X100 CMR control, R51, for best null on the oscilloscope.

THIS COMPLETES THE CALIBRATION PROCEDURE.

5.3 PERFORMANCE CHECKS - DEMODULATOR

a. CAL/SIG/ZERO

1. Set internal controls as follows (S5, 6, 7 and 8: select by CLOSING desired switch):

Output filters S5, S6 & S7. . . . . 40Hz
Carrier Frequency S8 . . . . . 400Hz
Cal. Polarity (S1). . . . . .Normal
SIG Polarity (S2). . . . . .Normal

2. Set front panel controls as follows:

Demodulator Section:

Volts Full Scale. 5V
X1/X10. . . . . X1
Variable Gain . . . . . Full CW
Cal/Sig/Zero . . . . . .Zero
Phase. . . . . Full CCW

DC Section:

Volts Full Scale..... 1V
Variable Gain ..... Full CW
Sig/Zero ..... Zero
X1/X100..... X1

3. Apply 10V within .1Vrms, 400Hz sine wave to the reference input pins 12 (high) and pins 13 and 14 (tied together), low. Connect a DVM and oscilloscope to the card edge output pins 2 (high) and 5 (low). Apply power and allow a 15 minute warm-up.

4. Set the Demodulator/DC switch on the front panel to Demodulator.

5. With the Cal/Sig/Zero switch in Zero, the output on the DVM should be 0.0 volts within 10mV. The scope should indicate less than 20mV peak-peak noise.

6. Set the Cal/Sig/Zero switch to Cal. Adjust the phase control near full CCW for a maximum POSITIVE output.

7. The reading on the DVM should be 5.0Vdc within 50mV and the residual second harmonic amplitude on the oscilloscope should be less than 50mV peak-peak.

8. Set the 3 output filters (S5, S6 and S7) to 120Hz and the carrier frequency (S8) to Hz. Change the reference frequency to 1200Hz. The DVM should read 5.0 volts DC within 50mV and the residual on the oscilloscope should be less than 50mV peak-peak.

9. Set the 3 output filters to 6 and the carrier frequency to 60. Change the reference frequency to 60Hz. The DVM should read 5.0 volts DC within 50mV and the residual on the oscilloscope should be less than 50mV peak-peak.

10. Increase the amplitude of the 60Hz reference from 10Vrms to 125Vrms within 1 volt. The DVM should still indicate 5.0 volts DC within 50mV and the residual on the oscilloscope should be less than 50mV peak-peak.

b. Common Mode

1. Set the reference input to 10Vrms within .1Vrms at 61Hz (approximately). Set the Cal/Sig/Zero switch to Sig, and the Demodulator full scale to .025V.

2. Connect a 1Kohm resistor between input pins 8 and 9. Connect pin 9 to pin 10.

3. Apply a 200V peak-peak (71Vrms) isolated 60Hz sine wave (See Figure 5-2) between input pin 10 and chassis. Connect the oscilloscope in a differential connection to the output pins 2 (high) and 5 (low).

4. Output on the oscilloscope should be less than 1.25V p-p at 1Hz for 90dB rejection.

5. Remove the high voltage, disconnect pin 9 from pin 10 and connect pin 10 to pin 8.

6. Apply the 200V peak-peak signal between pins 10 and chassis. Output on the oscilloscope should be less than 1.25V peak-peak for 90dB rejection.

7. Remove the high voltage from the inputs and disconnect the 1K resistor.

c. Full Scale Attenuator

1. Set the 3 output filters (S5, S6 and S7) to 40Hz and the carrier frequency (S8) to 400. Apply 10Vrms at 400Hz to the reference input, pin 12 (high) and pins 13 and 14 (tied together), low.

2. Also connect the 10 volt signal to the decade divider box with an input trimmer. (See Figure 5-3). Set the decade divider dials to 5000.

3. Monitor the output of the divider box with a DVM and set the trimmer for a reading of 3.535Vrms on the DVM with the dials at 5000. Connect the divider output to the AC signal channel input, pin 8 (high) and pins 9 and 10 (tied together), low. Connect a second DVM to the card edge output pins 2 (high) and 5 (low).

4. Set the Demodulator FULL SCALE to 5V and the CAL/SIG/ZERO switch to SIG. Peak the output using the phase control for a maximum POSITIVE output. The output on the DVM should be 5.0 volts DC within 50mV. Note this reading.

5. Check each position of the attenuator with decade dials set as per Table 5-1 below. In each step the output should be 5.0 volts DC within 25mV of the reading obtained in step 4 above.

NOTE: Leave second DVM connected to the output of the divider during all accuracy tests. Occassionally check this DVM for correct voltage at dial settings and adjust the trimmer as necessary.

TABLE 5-1
ATTENUATOR CHECKS

Decade Dials	Voltage (rms)	VFS
5000	3.5360	5
2500	1.7680	2.5
1000	.7072	1
0500	.3536	.5
0250	.1768	.25
0100	.0707	.1
0050	.0354	.05
0025	.0177	.025

d. X1/X10 Switch

1. Set the full scale switch to .1 and the decade dials to .0100. Output on the DVM should be 5.0 volts DC within 50mV. Note the reading.

2. Set the X1/X10 switch to X10 and change the decade dials to 1000. Output on the DVM should be 5.0 volts DC within 25mV of the reading obtained in step 1.

e. Variable Gain/Linearity

1. Set the VOLTS FULL SCALE to 2.5 and the X1/X10 switch to X1. Set the decade dials to 2500. Output on the DVM should be 5.0 volts DC within 50mV.

2. Rotate the VARIABLE GAIN control full CCW and insure that the DVM reading drops to less than 2 volts.

3. Set the VOLTS FULL SCALE to 1 volt and adjust the VARIABLE GAIN for a reading of approximately 5 volts on the DVM.

4. Apply 0 volts to the input and note the zero error. Reapply the voltage and adjust the variable gain for 5 volts plus the zero error. Insure both 0 and 5 volt readings have the same zero error.

5. Set the decade dials to the positions indicated and check for DVM outputs as per Table 5-2.

f. Cal. & Sig. Normal/Reverse Switches

1. Set the VOLTS FULL SCALE to 5 volts and VARIABLE GAIN to X1 (detent). Set the decade dials to 5000.

2. With the CAL/SIG/ZERO switch at CAL, the output on the DVM should be +5.0 volts DC within 50mV.

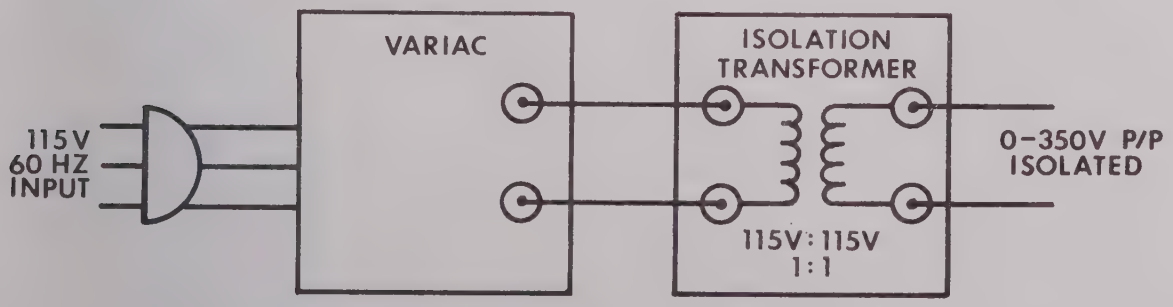


FIGURE 5-2

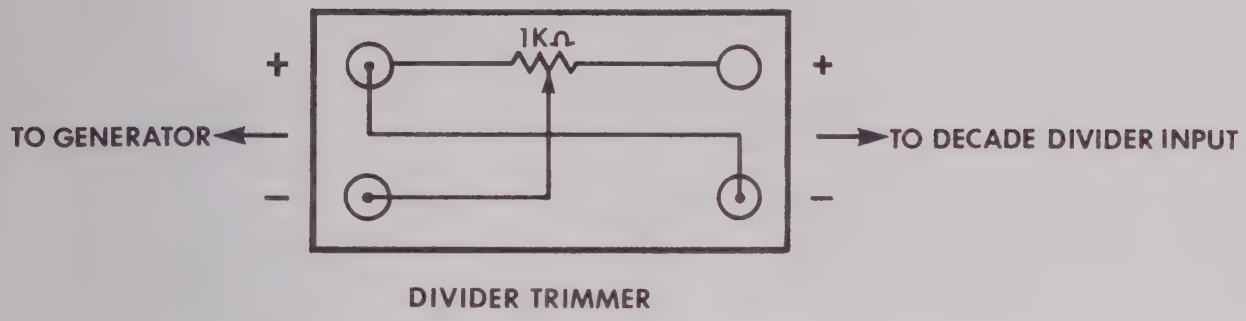


FIGURE 5-3 DIVIDER TRIMMER

3. Set Cal Reverse switch S1 to "R" (internal control). The DVM should now indicate -5.0 volts DC within 50mV.

4. Set S2 back to "N" and DVM should indicate +5 volts within 50mV.

5. Set the CAL/SIG/ZERO switch to SIG. DVM should indicate +5.0 volts DC within 50mV.

6. Set the signal reverse switch, S2 to "R". The DVM should now indicate -5V within 50mV.

7. Return S2 to "N" and output should be +5V within 50mV.

g. Phase

1. Arrange a phase shift input configuration as per Figure 5-4. Phase lock a 400Hz reference signal and set for 0 degrees phase shift.

2. With the DVM insure that the output of the decade box is 3.535Vrms.

3. Reconnect the DVM to the card edge output pin 2 (high) and 5 (low).

4. With the PHASE CONTROL set full CCW, peak the POSITIVE DC reading on the DVM by shifting the phase. A peak should be reached between 0 and -1 degrees. The DVM should read 5.0 volts DC within 50mV.

TABLE 5-2 LINEARITY CHECKS

Decade Dials	Voltage (rms)	DVM Reading
2500	1.7680	5.0Vdc plus zero error.
2000	1.4144	4.0Vdc within 25mV plus zero error.
1500	1.0608	3.0Vdc within 25mV plus zero error.
1000	.7072	2.0Vdc within 25mV plus zero error.
0500	.3536	1.0Vdc within 25mV plus zero error.
0000	.0000	0.0Vdc plus zero error.

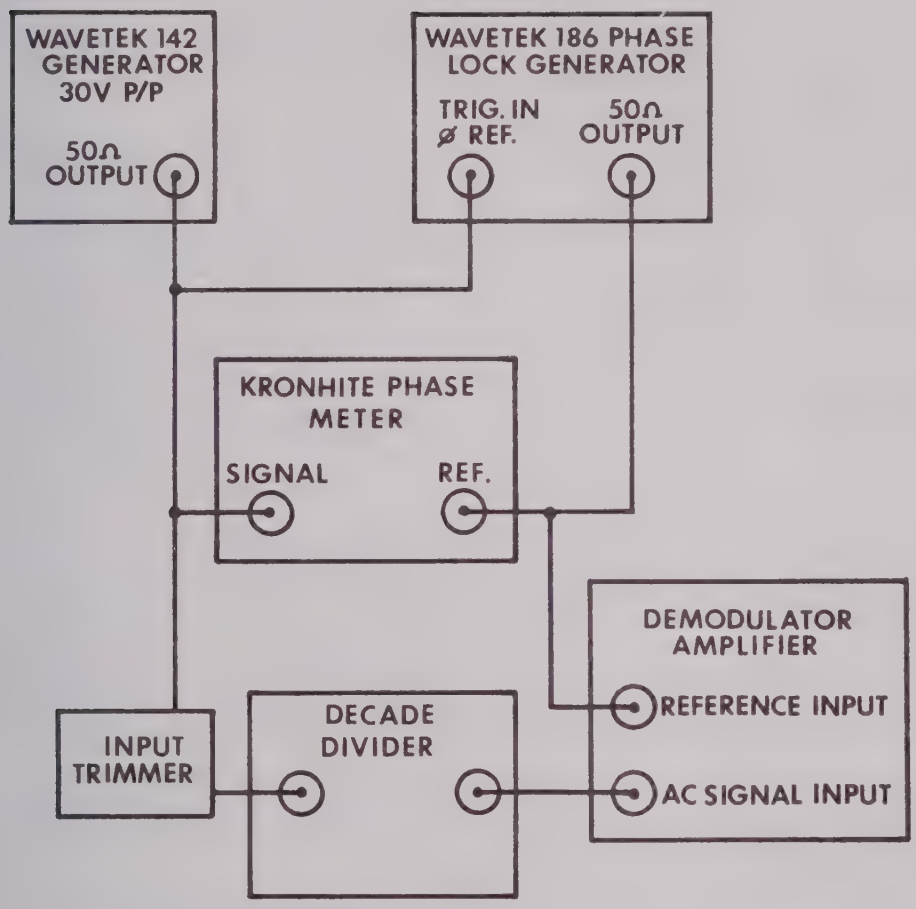


FIGURE 5-4 PHASE SHIFT

5. Set the PHASE CONTROL full CW and shift the input phase to near -170 degrees as read on the phase meter. A peak POSITIVE reading should be obtained at a phase shift between -165 degrees and -180 degrees. The DVM should read 5.0 volts DC within 50mV.

6. Set the phase shift for about -90 degrees as read on the phase meter. Peak the positive reading on the DVM by adjusting the PHASE CONTROL. A reading of 5.0 volts DC within 50mV should be obtainable near the center range of the phase control.

7. Disconnect the demodulator reference and signal from J101.

5.4 PERFORMANCE CHECKS - DC AMPLIFIER

a. Overvoltage Protection

1. Set the Demod/DC switch to DC and note the DC LED is on and the Demod LED is off.

2. Connect the DC Supply to the DC input pin 1 (high) and 2 and 3 (tied together), low. Set the DC FULL SCALE to 5 and the X1/X100 switch to X100. Set the SIG/ZERO switch to SIG.

3. Apply +500 volts DC to the input. The output on the DVM should read 5.0 volts DC within 50mV.

4. Rotate the full scale switch thru all positions and actuate the X1/X100 switch.

5. Return the X1/X100 switch to X100 and the VOLTS FULL SCALE to 5V. The DVM should read 5.0 volts DC within 50mV.

   NOTE: If overvoltage condition exists for more than 1 minute, ample time must be allowed for restabilization.

6. Remove the 500 volts DC.

b. Common Mode

1. Set the output filters (S5, S6 and S7) for no filtering (open). Connect a 1Kohm resistor between input pins 1 and 2. Connect input pin 3 to pin 1. Set volts full scale to .025. Set X1/X100 switch to X1.

2. Connect an oscilloscope with differential input to card edge output pins 2 (high) and 5 (low).

3. Apply a 30 volts peak-peak, 60Hz sine wave between input pin 3 and chassis ground. The scope should show less than 1.9 volts peak-peak at 60Hz for a 70dB rejection.

4. Remove connection between pin 3 and pin 1 and connect pin 3 to pin 2.

5. With the 30 volts applied, the output should again be less than 1.8 volts peak-peak for a 70dB rejection.

6. Remove connection between pins 3 and 2.

c. Normal Mode

1. Connect a 1Kohm resistor between input pins 1 and 2. Apply 5 volts peak-peak, 60Hz sine wave between pins 1 and 3. The scope output should be less than 3 volts peak-peak.

2. Remove the 1K resistor.

d. Frequency Response

1. Connect the sine wave generator to input pins 1 (high) and 2 and 3 (tied together), low. Connect the oscilloscope to output pins 2 (high) and 5 (low). DC couple the scope.

2. Set the full scale to 5V, X1/X100 to X1 and SIG/ZERO to SIG. Set output filters (S5, S6 and S7) for maximum bandpass (no filtering).

3. Apply a 100Hz sine wave to the input. Monitor the input amplitude with a DVM and adjust for exactly 1.7680Vrms.

4. Connect the DVM to the card edge output pins 2 (high) and 5 (low). The output on the DVM should read no less than 1.59Vrms.

5. Set the output filters for 6Hz and set the input frequency to 6Hz.

6. Run the chart recorder. Trace must be at least 90% of full scale.

7. Stop the chart recorder. Set the filters for 40Hz and change the input frequency to 40Hz. The output on the DVM should be greater than 1.59Vrms and the scope should indicate greater than 4.5V peak-peak.

8. Set the output filters for 120Hz and change the input frequency to 120Hz. The output on the DVM should be greater than 4.5 volts peak-peak.

9. Set the output filters to the 40Hz position.

e. SIG/ZERO switch

1. Set the SIG/ZERO switch to ZERO. The output on the DVM should be 0.0 volts DC within 10mV and the noise on the scope should be less than 50mV peak-peak.

2. Rotate the DC VARIABLE GAIN control full CCW and back to full CW. The DVM output should not change by more than 10mV.

f. Full Scale Attenuator

1. Set the SIG/ZERO switch to SIG and connect a DC supply to input pins 1 (high) and 2 and 3 (tied together), low.

2. Apply input voltages with the full scale switch set as per Table 5-3. In each step the output should be 5.0 volts DC within 25mV and noise on the scope should be less than 20mV peak-peak.

TABLE 5-3
ATTENUATOR CHECKS

FULL SCALE	INPUT
5	5.0V
2.5	2.5V
1	1.0V
.5	0.5V
.25	0.25V
.1	0.1V
.05	0.05V
.025	0.025V

g. X1/X100 Switch

1. With the FULL SCALE switch set to .1 and .1V applied, the DVM should read 5.0 volts DC within 25mV. Note this reading.

2. Set the X1/X100 switch to X100 and change the input voltage to 10 volts DC.

3. The DVM should read 5.0 volts DC within 25mV of the reading obtained in step 1.

4. Return the X1/X100 switch to X1.

h. Sensitivity/Linearity

1. Set the FULL SCALE switch to 2.5 and apply 2.5 volts to the input (pin 1 (high) pins 2 and 3 (tied together)). The output on the DVM should be 5.0 volts DC within 25mV. Rotate the variable gain control full CCW and insure that the DVM reading drops to less than 2 volts.

2. Set the FULL SCALE switch to 1 volt and adjust the VARIABLE GAIN for approximately 5 volts.

3. Apply 0 volts to the input and note the zero error. Reapply the voltage and readjust the variable gain for 5 volts DC plus the zero error. Insure that the 0 volt and 5 volt outputs have the same zero error.

4. Apply voltage per Table 5-4 and insure correct outputs:

TABLE 5-4
LINEARITY CHECK

INPUT VOLTAGE	DVM OUTPUT
2.5V	5.0V plus zero error
2.0V	4.0V within 25mV plus zero error
1.5V	3.0V within 25mV plus zero error
1.0V	2.0V within 25mV plus zero error
0.5V	1.0V within 25mV plus zero error
0.0V	0.0V plus zero error

SECTION VI

PARTS IDENTIFICATION

6.1 GENERAL

This instrument has been accurately calibrated and adjusted before shipment from the factory and should give long, trouble-free service. For servicing beyond the scope fo the instructions contained in this manual or the technical equipment available, contact your nearest Gould Service Engineer listed on the warranty card shipped with the instrument.

The following parts lists and schematic diagrams are designed to assist in servicing and repairing the instrument.

NOTE: Check to be sure the schematic number and revision letter stamped on the rear of the instrument agree with the number and revision letter on the schematic contained in this section.

To assure prompt and satisfactory delivery of replacement parts, include the following with the purchase order:

1. Name, model number and serial number of the instrument.

   For Example: Demodulator Amplifier, Model 13-4616-005323, serial number XXX.

2. Description of the parts as listed in the manual.

3. Gould part number.

NOTE: Do not use the SYMBOL NUMBER from the parts list for identifying desired parts on the order.

6.2 ATTACHING PARTS (A-P)

Hardware required (but not illustrated) to attach the previous listed item to the illustrated assembly.

NOTES

1. **Do not use the SYMBOL NUMBER from the parts list for identifying desired parts on the order.**

2. **†Obelisk indicates items not procurable as an assembly.**

EXPLODED VIEW PARTS LIST
DEMODULATOR/DC AMPLIFIER ASSEMBLY
MODEL 13-4616-005323
FIGURE 6-1

ITEM NUMBER	PART NUMBER	DESCRIPTION	SYMBOL NUMBER
	13-4616-005323	Demodulator/DC Amplifier Assembly	
	686421	Cover Assembly	
1		Cover	
2		Insulation	
3	685944-1	Frame	
	895751	Harness Assembly (A-P)	
	663800-1	Knurled Nut	
		------*------	
4	1-287490	Contact, Electrical	
5	287491-2	Connector	XDS-101, XDS-102
6	268923	Switch	S-103
7	295786	Resistor	R-101
8	269960	Switch	S-107
9	293994-9	Connector	P-2
10	293944-4	Connector	P-5
11	232997-23	Retainer, Strap	
	795948	Panel Assembly, Rear (A-P)	
	13-262716-4006	Screw	
		------*------	
12	795382	Panel, Rear	
13	295344	Connector (A-P)	J-101
	31-119918-4012	Screw	
	243898-40	Nut Assembly	
		------*------	
14	266917-1	Spacer	
15	895744	Board Assembly, Demod/DC (A-P)	
	13-262716-4004	Screw	
		------*------	
	895750	Cable Assembly (A-P)	
	663800-1	Knurled Nut	
		------*------	
16	1-287490	Contact, Electrical	
17	293944-9	Connector	J-1
18	269960	Switch	S105, S106
19	232997-23	Retainer	
20	285943	Cover	
21	395726	Panel, Sub (A-P)	
	13-262715-4004	Screw	
		------*------	
22	795735	Panel Assembly, S.S.	
23	285653-1	Knob	

EXPLODED VIEW PARTS LIST
DEMODULATOR/DC AMPLIFIER ASSEMBLY
MODEL 13-4616-005323
FIGURE 6-1

ITEM NUMBER	PART NUMBER	DESCRIPTION	SYMBOL NUMBER
24	285651-14	Knob	
25	694245	Knob Assembly, Locking (A-P)	
	1-293279-1	Nut, Hex	
		-----*-----	
26	285651-3	Knob	
27	289396	LED	

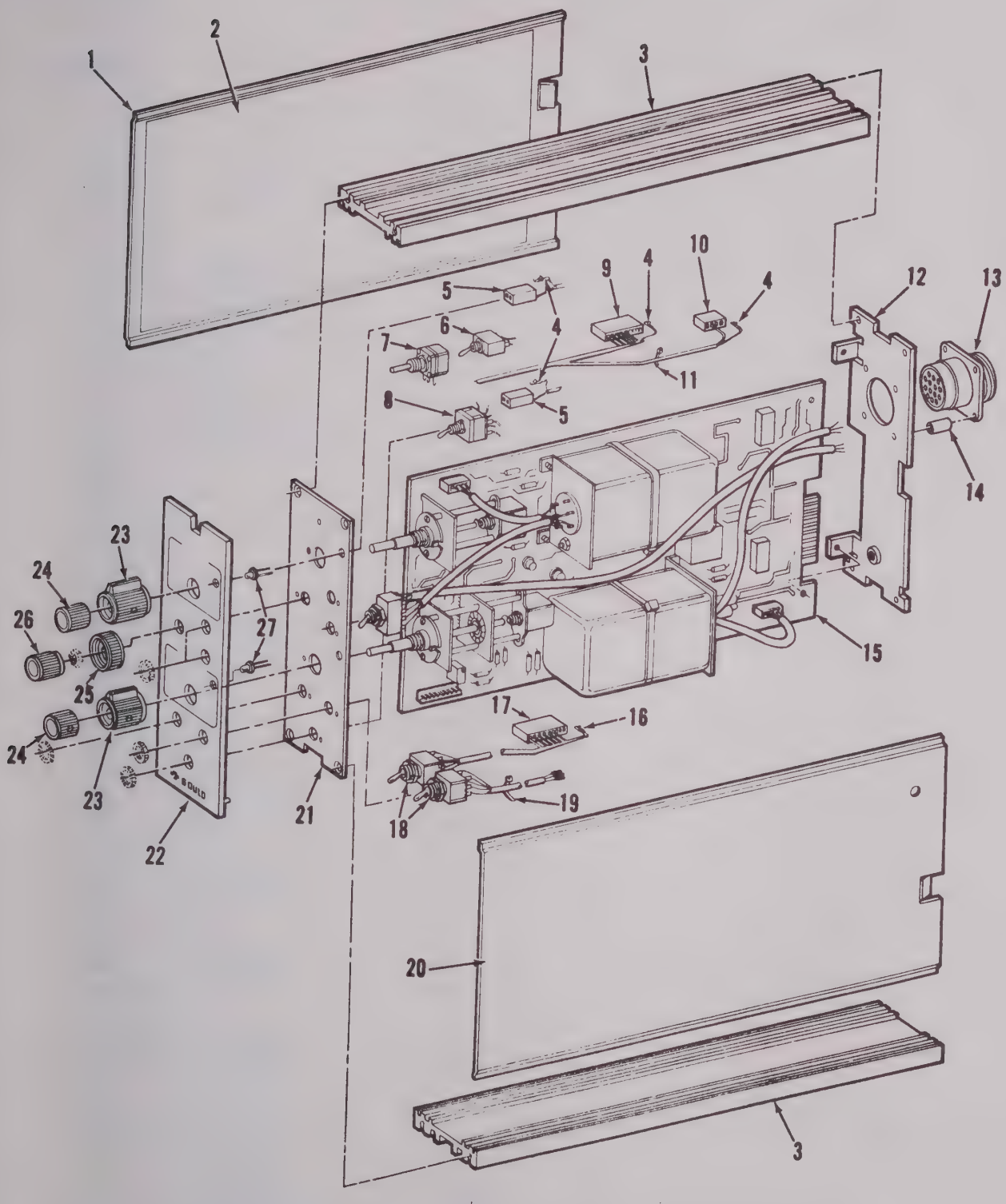


FIGURE 6-1 EXPLODED VIEW DEMODULATOR AMPLIFIER ASSEMBLY
13-4616-005323

ELECTRICAL PARTS LIST
BOARD ASSEMBLY, DEMODULATOR/DC AMPLIFIER (SCHEMATIC 295744)
FIGURE 6-2

SYMBOL	PART NUMBER	DESCRIPTION
C1	10-288757-100	Capacitor
C2	287614-104	Capacitor
C3	10-291759-224	Capacitor
C4	262585-106	Capacitor
C5	10-291759-224	Capacitor
C6	10-291759-333	Capacitor
C7	10-291759-123	Capacitor
C8	10-291759-333	Capacitor
C9	10-291759-123	Capacitor
C10	10-291759-154	Capacitor
C11	10-291759-223	Capacitor
C12	10-291759-822	Capacitor
C13	Not Used	
C14 thru C17	20-263695-105	Capacitor
C18 thru C20	287614-104	Capacitor
C21	10-291759-224	Capacitor
C22	10-291759-333	Capacitor
C23	10-291759-103	Capacitor
C24	262581-503	Capacitor
C25	10-291759-182	Capacitor
C26	Not Used	
C27	240352-501	Capacitor
C28	289101-566	Capacitor
CR1	293563-1	Diode
CR2 thru CR5	280440	Diode
CR6, CR7	291152	Diode
CR8, CR9	293563-1	Diode
J1, J2	1-293983-9	Connector
J3 thru J5	1-293983-4	Connector
J6	1-287495-7	Connector
Q1	281702-2	Transistor
R1	25-288308-90000	Resistor
R2	25-288308-25000	Resistor
R3	25-288308-15000	Resistor

ELECTRICAL PARTS LIST
BOARD ASSEMBLY, DEMODULATOR/DC AMPLIFIER (SCHEMATIC 295744)
FIGURE 6-2 (Continued)

SYMBOL	PART NUMBER	DESCRIPTION
R4	25-288308-500R0	Resistor
R5	25-288308-250R0	Resistor
R6	25-288308-150R0	Resistor
R7, R8	25-288308-50R00	Resistor
R9	5-241111-203	Resistor
R10	269085-203	Resistor
R11	1-288308-41402	Resistor
R12	Not Used	
R13	269085-103	Resistor
R14, R15		
R16	1-288308-50000	Resistor
R17	R1-288308-30000	Resistor
R18	R1-288308-72001	Resistor
R19 thru R21	1-288308-20001	Resistor
R22	1-288308-60001	Resistor
R23	1-288308-15001	Resistor
R24	R1-288308-323R3	Resistor
R25 thru R27	5-241111-103	Resistor
R28	1-288308-41201	Resistor
R29	1-288308-90001	Resistor
R30	1-288308-10001	Resistor
R31	1-288308-30001	Resistor
R32, R33	1-288308-20002	Resistor
R34	1-288308-10002	Resistor
R35	1-288308-20002	Resistor
R36	5-115557-271	Resistor
R37	1-288308-30002	Resistor
R38	269085-102	Resistor
R39	5-115557-222	Resistor
R40	1-288308-41201	Resistor
R41	1-288308-10001	Resistor
R42	1-288308-18001	Resistor
R43	1-288308-20000	Resistor

ELECTRICAL PARTS LIST
BOARD ASSEMBLY, DEMODULATOR/DC AMPLIFIER (SCHEMATIC 295744)
FIGURE 6-2 (Continued)

SYMBOL	PART NUMBER	DESCRIPTION
R44, R45	1-288308-10001	Resistor
R46	1-288308-30001	Resistor
R47	269085-103	Resistor
R48, R49	R1-286685-10003	Resistor
R50	R1-284694-10101	Resistor
R51	269085-201	Resistor
R52	R1-284694-10101	Resistor
R53	25-288308-50002	Resistor
R54	25-288308-25002	Resistor
R55	25-288308-15002	Resistor
R56	25-288308-50001	Resistor
R57	25-288308-25001	Resistor
R58	25-288308-15001	Resistor
R59, R60	25-288308-50000	Resistor
R61	25-288308-50002	Resistor
R62	25-288308-25002	Resistor
R63	25-288308-15002	Resistor
R64	25-288308-50001	Resistor
R65	25-288308-25001	Resistor
R66	25-288308-15001	Resistor
R67, R68	25-288308-50000	Resistor
R69, R70	5-115557-474	Resistor
R71	269085-103	Resistor
R72	1-288308-10001	Resistor
R73	1-288308-66201	Resistor
R74	1-288308-10000	Resistor
R75	1-288308-66201	Resistor
R76 thru R78	1-288308-10001	Resistor
R79	Not Used	
R80	1-288308-50000	Resistor
R81	269085-103	Resistor
R82, R83	1-288308-10002	Resistor
R84	1-288308-90001	Resistor
R85, R86	269085-203	Resistor
R87	Not Used	
R88	1-281851-34001	Resistor
R89	1-288308-10001	Resistor
R90	5-241111-103	Resistor

ELECTRICAL PARTS LIST
BOARD ASSEMBLY, DEMODULATOR/DC AMPLIFIER (SCHEMATIC 295744)
FIGURE 6-2 (Continued)

SYMBOL	PART NUMBER	DESCRIPTION
R91	Not Used	
R92	1-288308-20001	Resistor
R93	1-288308-50000	Resistor
R94	Not Used	
R95	5-241111-101	Resistor
R96	1-288308-10002	Resistor
R97	1-288308-20000	Resistor
R98	25-288308-90000	Resistor
R99, R100	1-288308-10000	Resistor
S1	293438	Switch, Slide, DPDT
S2	289742	Switch, Slide, SPDT
S101, R101	695645	Switch Assembly
S102, R102	695784	Swtich Assembly
S5 thru S8	286142-3	Swtich, DIP
T1	895749	Transformer Assembly (See Figure 6-3)
T2	795748	Transformer Assembly (See Figure 6-4)
TP1 thru TP5	265763-3	Contact, Electrical
U1	292885	Integrated Circuit
U2	291062-3	Integrated Circuit
U3	283948	Integrated Circuit
U4	291062-3	Integrated Circuit
U5	294181-2	Integrated Circuit
U6	283948	Integrated Circuit
U7	295785	LED Photocell
U8	292885	Integrated Circuit
U9	294181-2	Integrated Circuit
VR1	289388	Voltage Regulator
VR2	289897	Voltage Regulator

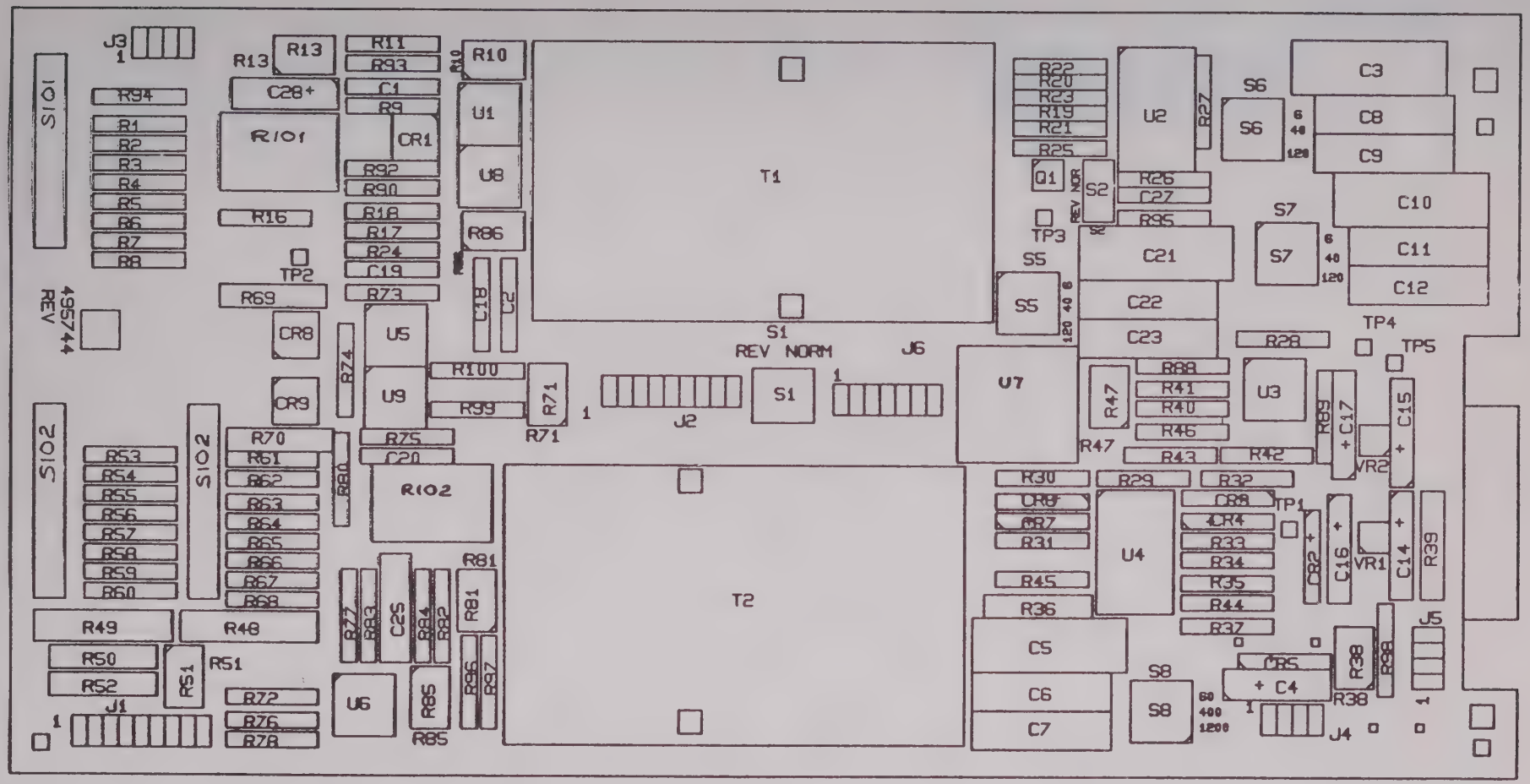


FIGURE 6-2 BOARD ASSEMBLY, DEMODULATOR/DC AMPLIFIER
(SCHEMATIC 295744)

TRANSFORMER ASSEMBLY (895749)
PARTS LIST
FIGURE 6-3

ITEM NUMBER	PART NUMBER	DESCRIPTION	SYMBOL NUMBER
	895749	Transformer Assembly	
† 1	861810-443	Cable Assembly	
† 2	861810-444	Cable Assembly	
3	232223	Transformer	T-1
4	241096	Bracket	
		(A-P)	
	243898-62	Nut Assembly	
		------*------	
5	293994-4	Connector	
6	291996-1	Switch	S-104
† 7	861810-448	Cable Assembly	
8	1-287490	Contact, Electrical	

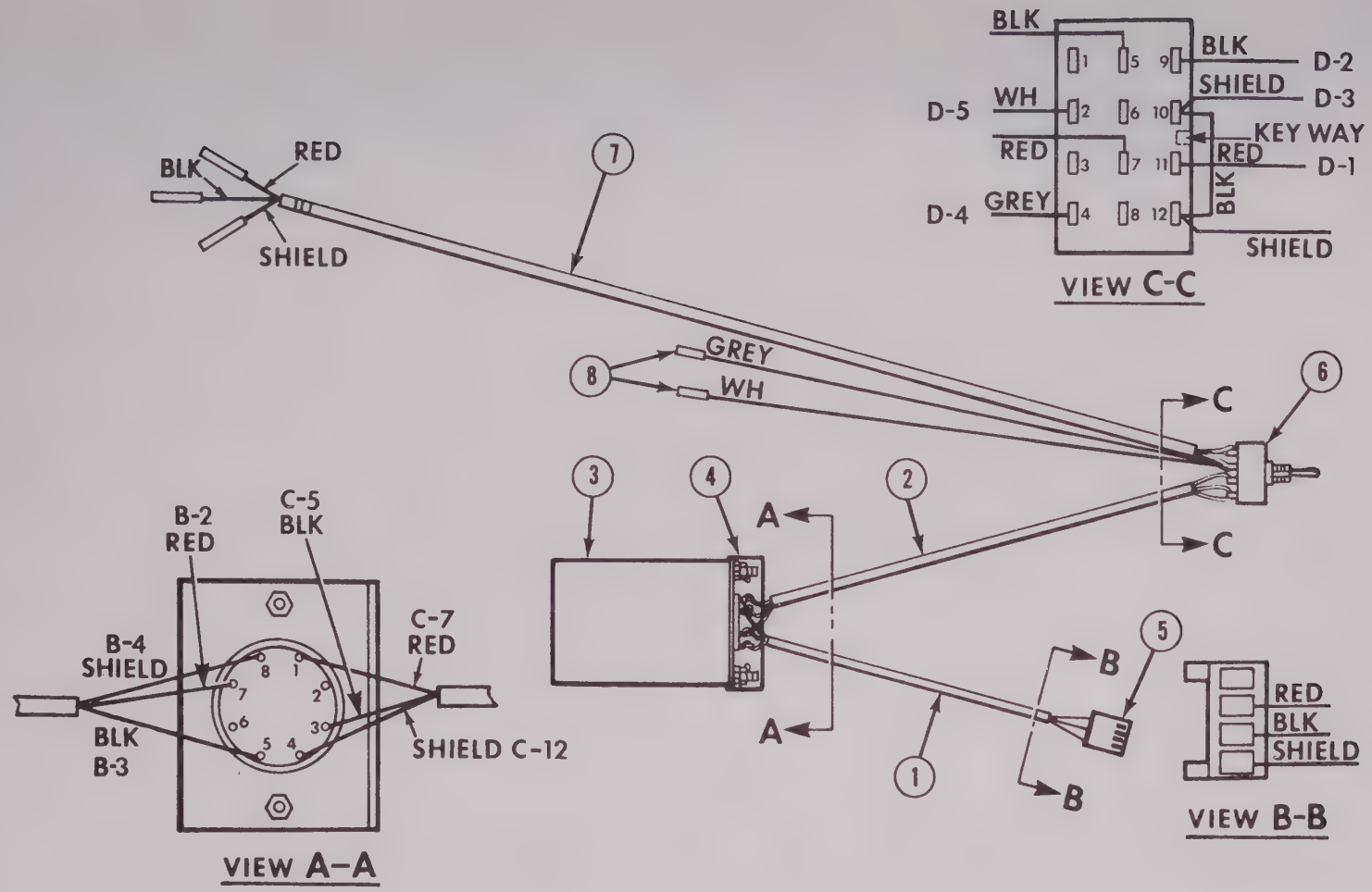


FIGURE 6-3 TRANSFORMER ASSEMBLY (895749)

TRANSFORMER ASSEMBLY (795748)
PARTS LIST
FIGURE 6-4

ITEM NUMBER	PART NUMBER	DESCRIPTION	SYMBOL NUMBER
	795748	Transformer Assembly	
1	232223	Transformer	
2	241096	Bracket	
		(A-P)	
	243898-62	Nut Assembly	
		_____*_____	
† 3	861810-446	Cable Assembly	
† 4	861810-447	Cable Assembly	
5	293994-4	Connector	

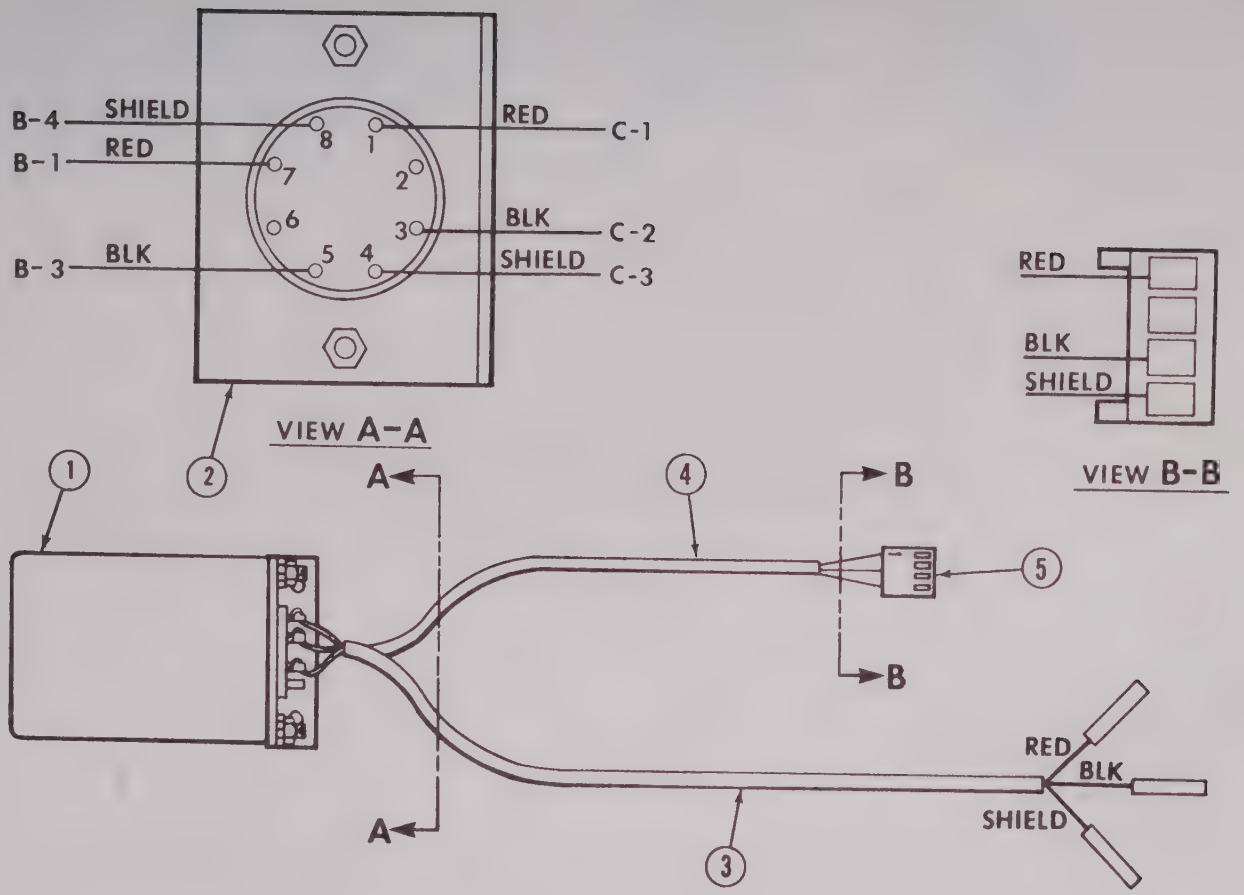
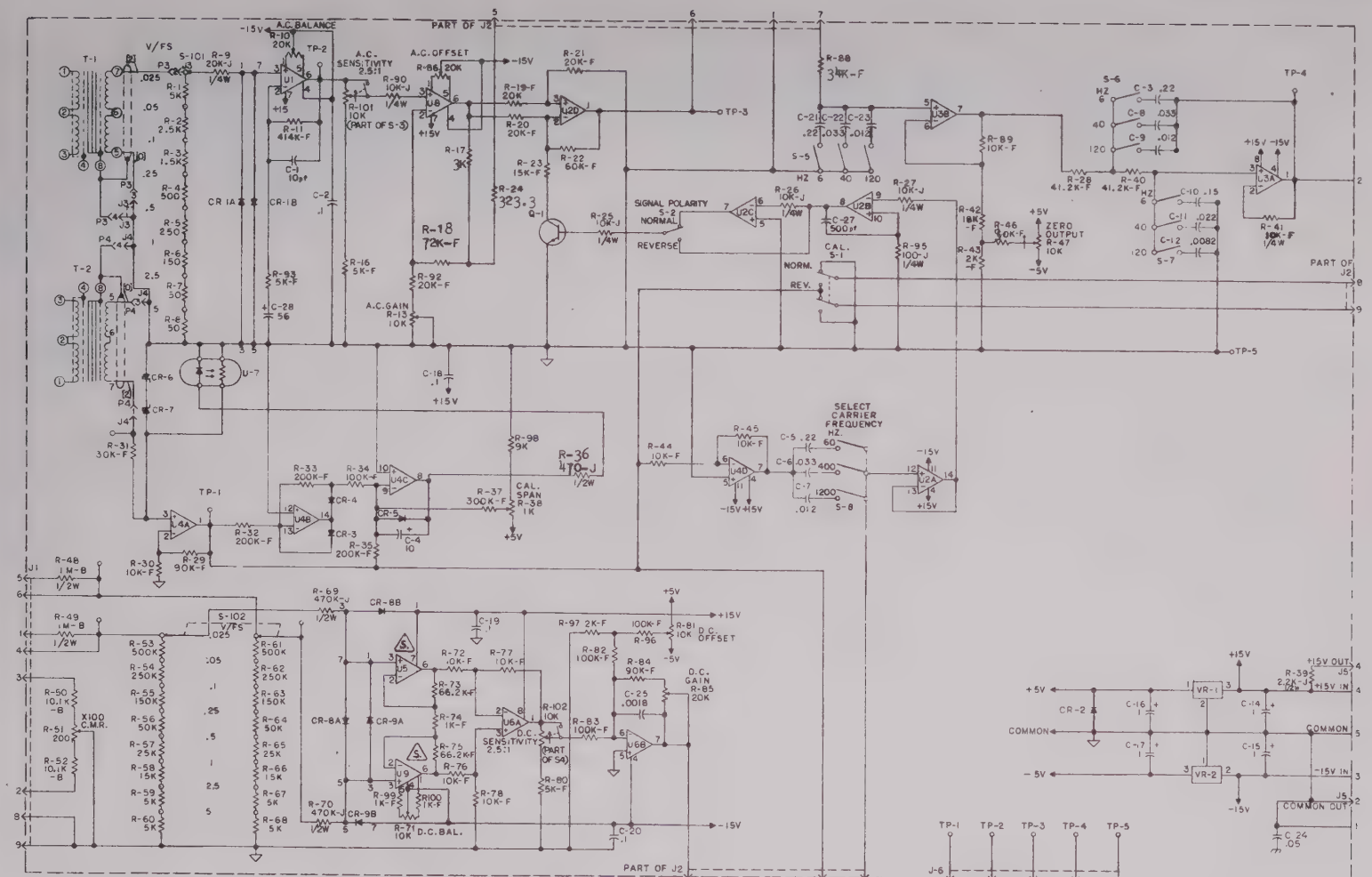


FIGURE 6-4 TRANSFORMER ASSEMBLY (795748)

P-1

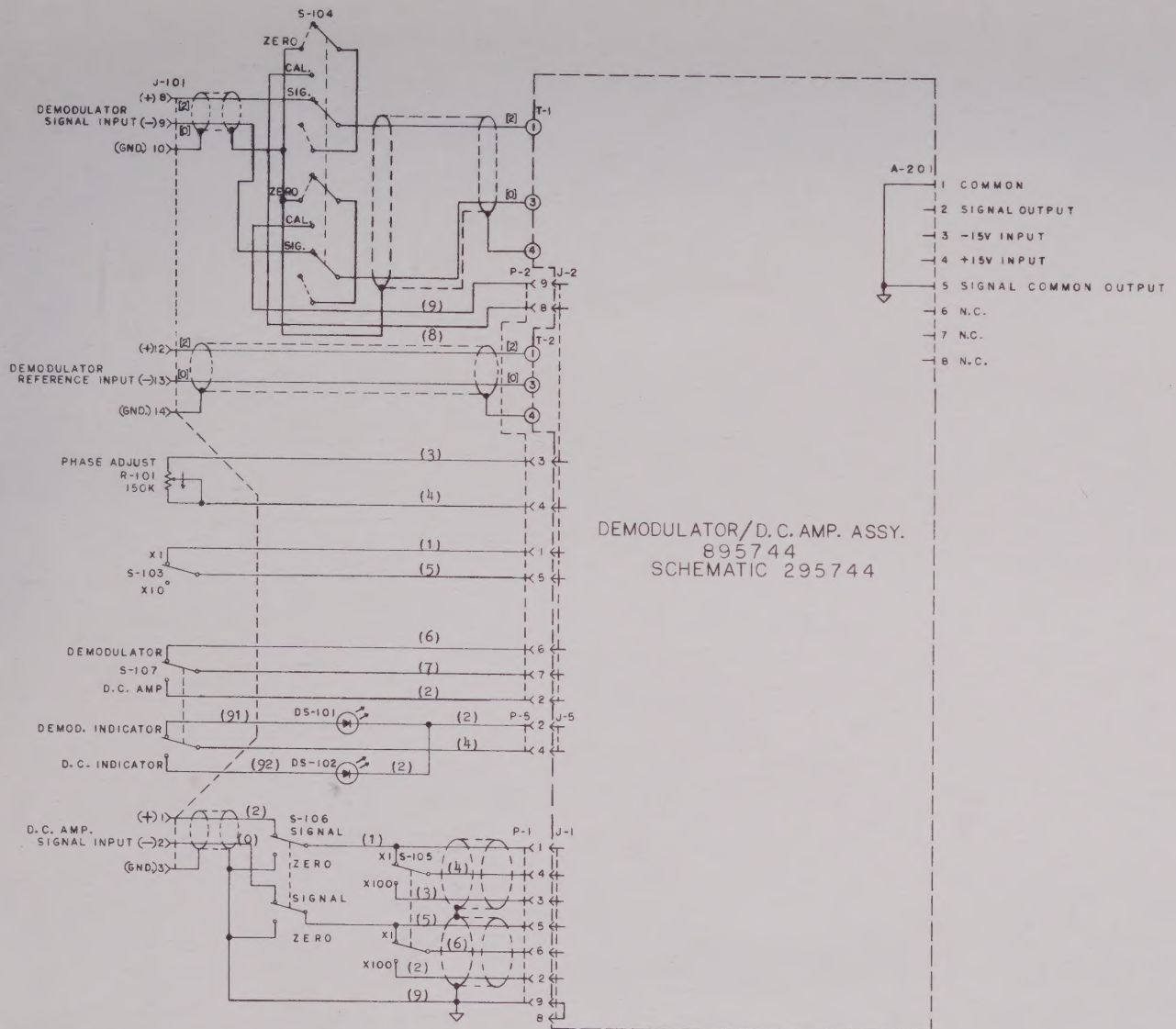


NOTE: 1. UNLESS OTHERWISE INDICATED:
ALL CAPACITANCE IN MICROFARADS.
ALL RESISTANCE IN OHMS.
ALL RESISTORS 1/8 WATT, .25%.
B = .1%
F = 1%
J = 5%
2. ALL VOLTAGES REFERENCED TO GROUND.
3. ( )= E.I.A. COLOR CODE.

⚠S THIS BOARD CONTAINS STACTIC SENSITIVE COMPONENTS AND MUST BE HANDLED PER MEI-0011.

BY	DATE	NAME	SCHEMATIC
DR. FOWLER	11/81	BD. ASSY.	895744
CH.	11/81	CODE IDENT.	96795
APP.		ISSUE CODE	G

Gould Inc.
Instruments Division
Cleveland, Ohio 44114 U.S.A.
SIZE 295744



DEMODULATOR/D.C. AMP. ASSY.
895744
SCHEMATIC 295744

NOTE: 1. ( ) = E.I.A. COLOR CODE.

REVISIONS		
ZONE	DESCRIPTION	DATE

AMPLIFIER ASSY., DEMOD./DC 13-4616-00

BY	DATE	NAME	SCHEMATIC	Gould Inc. Instruments Division Cleveland, Ohio 44114 U.S.A.
DR FOWLER	11/8/61			
CHK Herrick	11/20/61			
APP	11/21/61	CODE IDENT. 96795	ISSUE CODE G	DWG. NO. 295949

295949